# The World Ocean Database:

Aggregating Observing System Data for ocean monitoring and research

National Centers for Environmental Information

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World Ocean Database: World's largest publicly available uniformly formatted and quality controlled oceanographic profile database
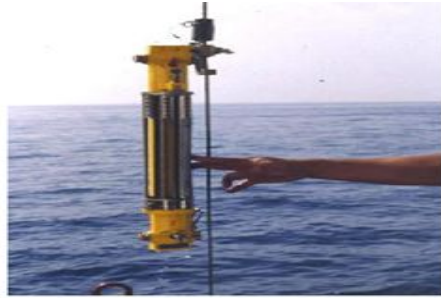
a) bottle/reversing therm. b) MBT c) XBT d) CTD

e) towed CTD f) profiling float g) moored buoy h) ice-tethered profiler
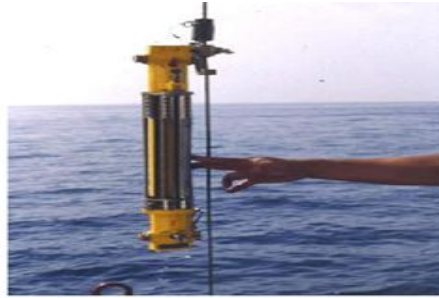
i) instrumented animal j) glider k) surface j) Plankton tow

Glider photo Robert Todd WHO fromhttps://www.coastalstudiesinstitute.org/gliders-mobile-oceanographic-observing-platforms/
Ice-tethered profiler photo John Kemp WHOI https://phys.org/news/2015-03-ice-tethered-devices-arctic-ocean.html

World Ocean Database: Aggregation and reuse of data for ocean/climate study with essential ocean variable (EOV) focus

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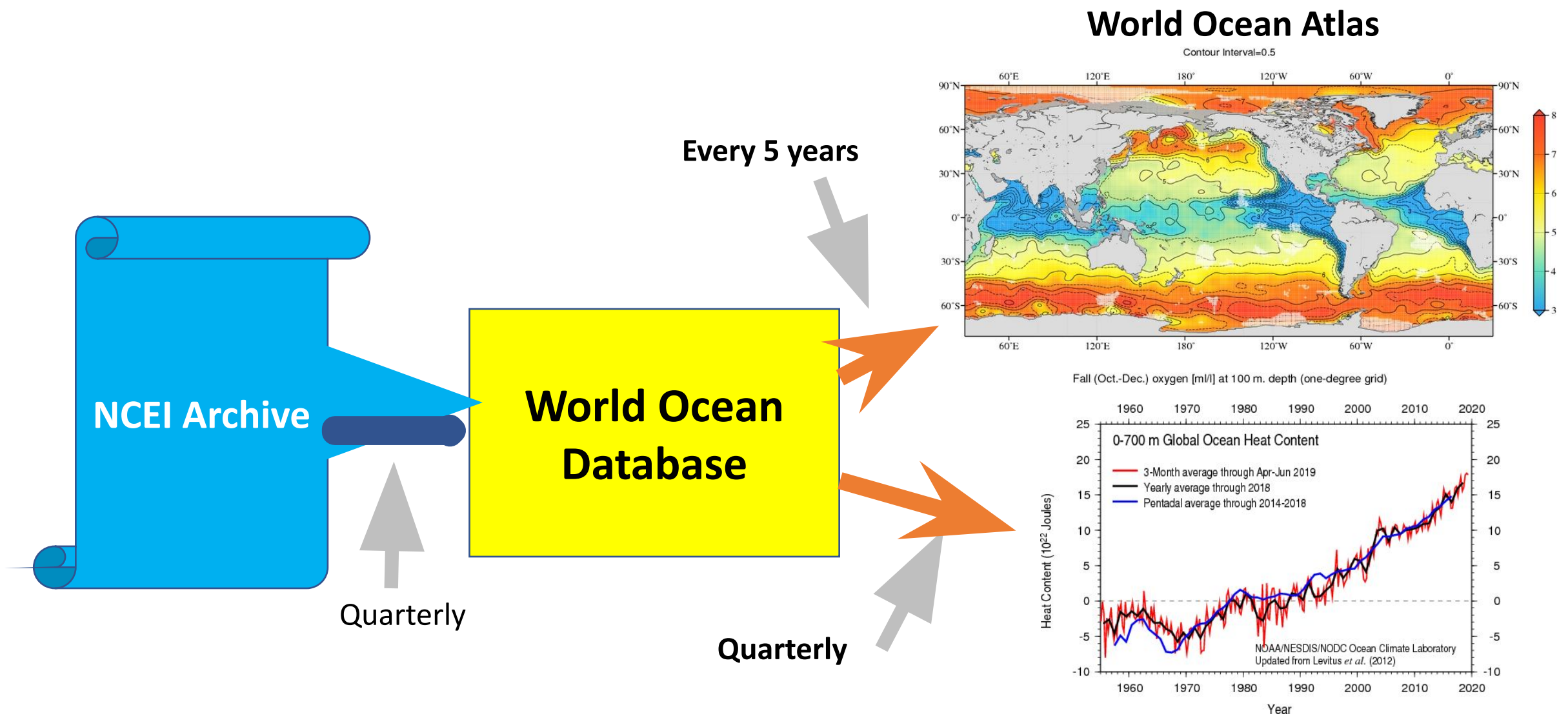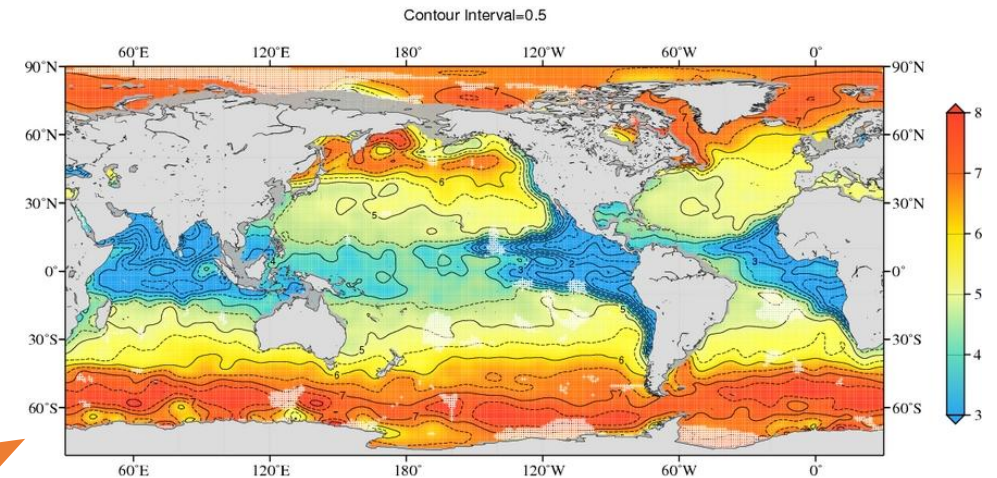
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World Ocean Atlas

Every 5 years

NCEI Archive

World Ocean Database

Quarterly

Quarterly

Ocean Heat Content Time Series

22,000+ archived ocean profile datasets organized for monitoring and research

World Ocean Atlas
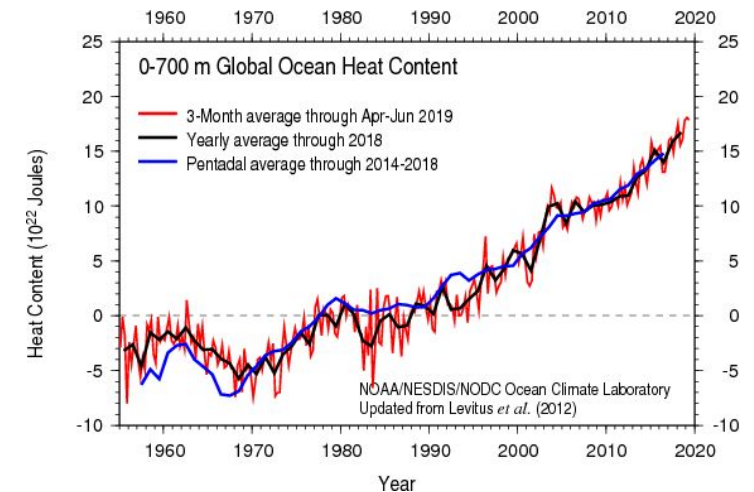
Ocean Heat Content Time Series

The archive is vital to the preservation of original data, data as utilized in any particular monitoring effort/research

NOAA World Ocean Database (WOD)
Physical, chemical, and biological ocean profile data (1772–2022): 17.7M casts

WOD is an IOC IODE Project for and by all countries providing open and unrestricted data discovery and access equity (FAIR-compliant).
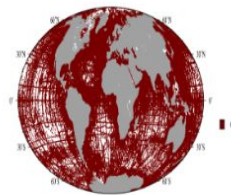https://www.ncei.noaa.gov/products/world-ocean-database

National and international data sources

National and international data products

WOD ocean profile data with quality-control

Supports

Center for Marine Meteorology and Ocean Climate Data (CMOC)/JCOMM Marine Climate Data System (MCDS)

Ocean Modeling

Ocean Heat Content

World Ocean Atlas

IQUOD ternational Quality Controlled Ocean Database for Temperature
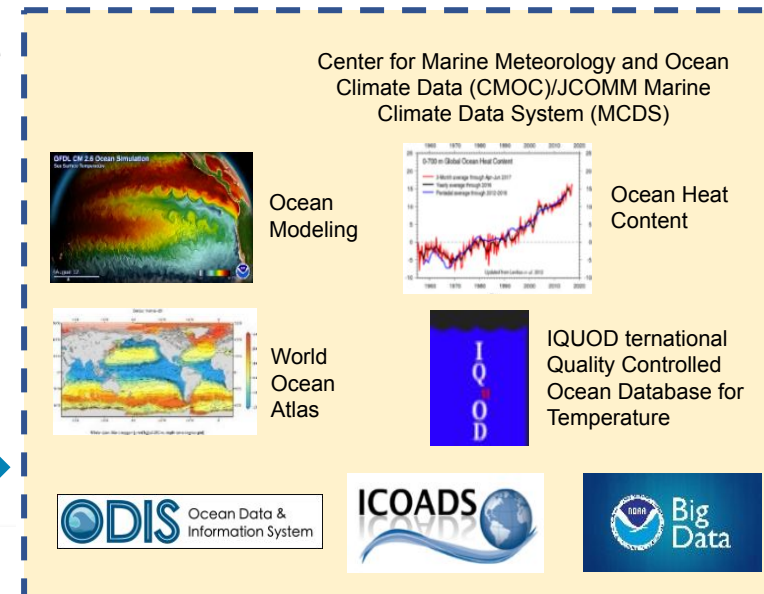
Yearly Count of Ocean Casts in the World Ocean Database

Legend:
- OSD
- MBT
- XBT
- CTD
- PFL
- DRB
- XCTD
- UOR
- GLD
- MRB
- APB
- DBT
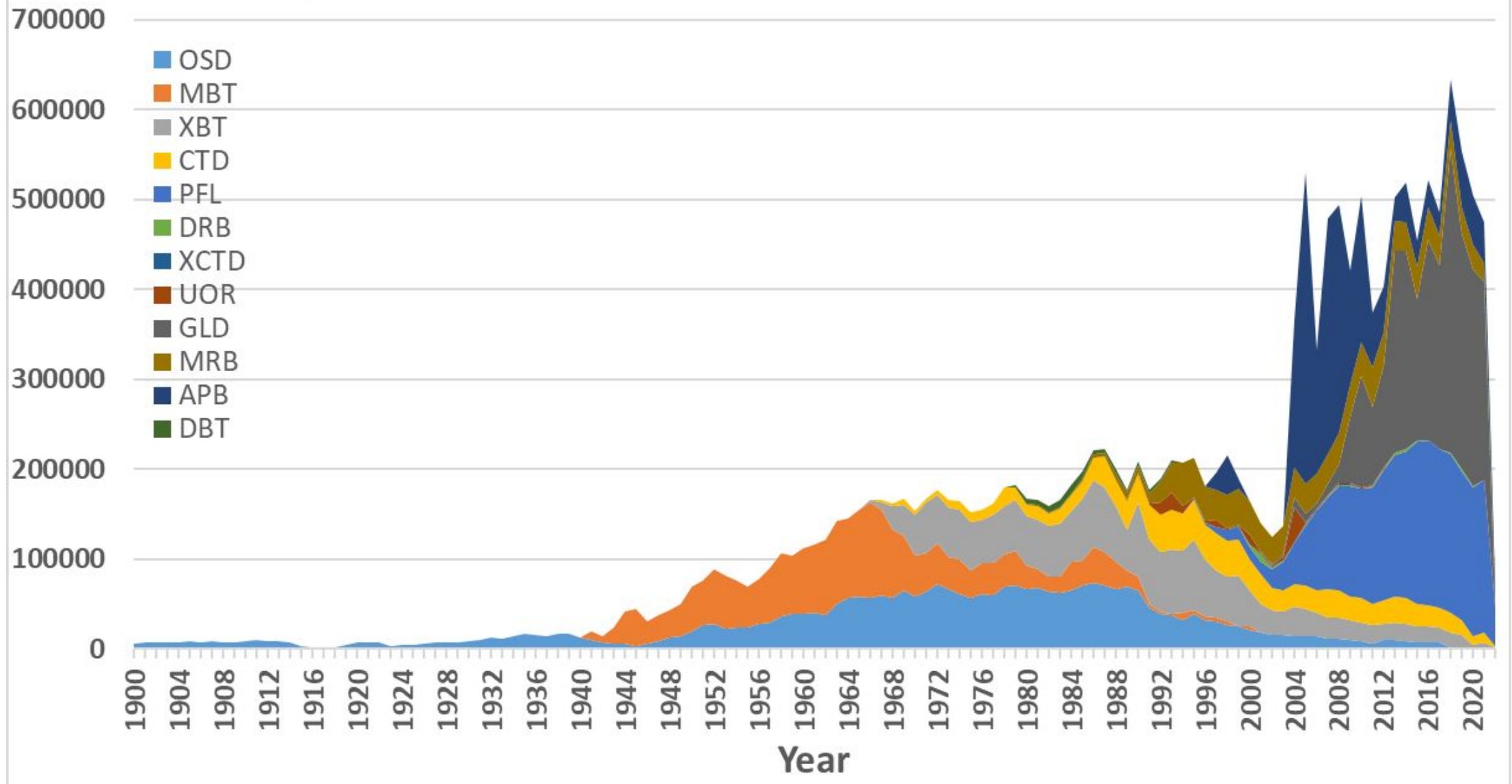
Year

Yearly Count of Oxygen Profiles
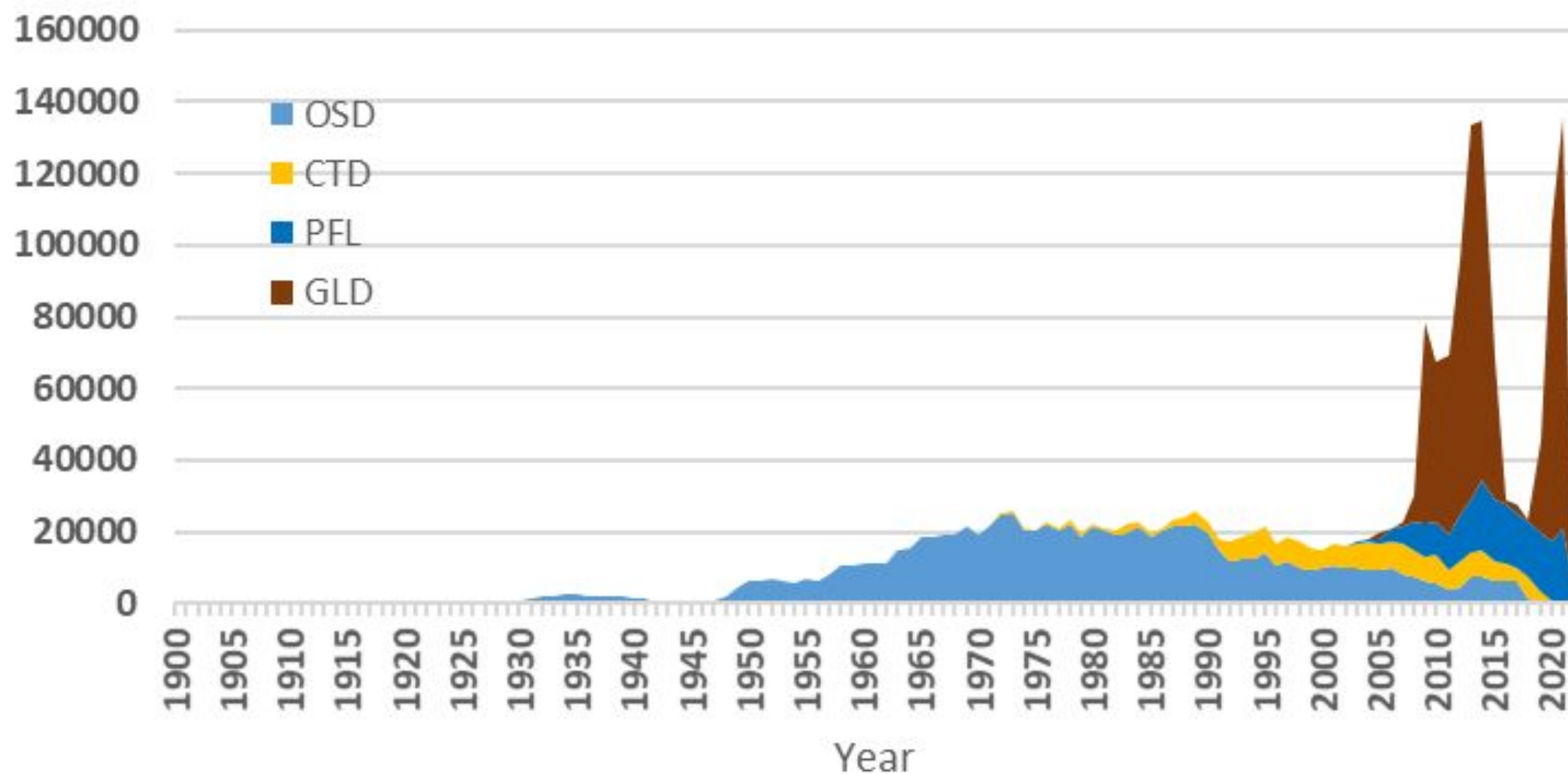
Real Flow of Data from Originator to WOD
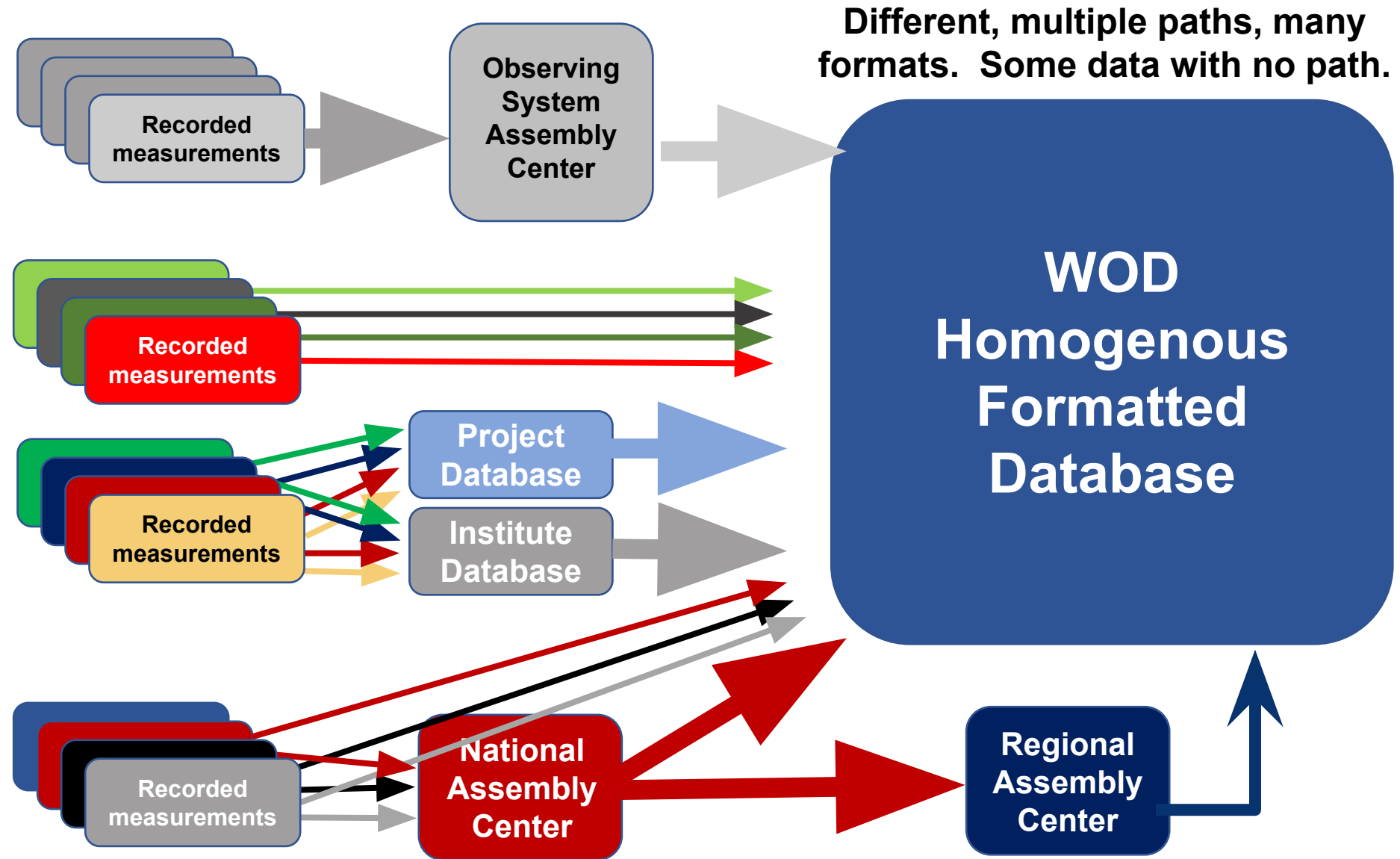
International Quality-Controlled Ocean Database (IQuOD) v0.1: The Temperature Uncertainty Specification – Cowley et al 2021

- **Exploration of manufacturer specifications for instrument types, peer-reviewed journal articles on measurement and instrumentation methods, project and institution guidelines for measurement, calibration information, etc.**

- **Define uncertainties in temperature and depth/pressure for major instrumentation categories.**

- **Assign uncertainties to each measurement in the IQuOD v0.1 https://doi.org/10.7289/v51r6nsf**

https://doi.org/10.3389/fmars.2021.689695

Instrument type	Temperature (°C)	Depth/Pressure
Bottle/reversing thermometer	0.02	5%
CTD (Conductivity, Temperature, Depth) (pre-1980)	0.01	0.08%
CTD calibrated (post-1980)	0.002	0.015%
CTD animal mounted	0.005	-
CTD towed, UOR (Undulating Oceanographic Recorder)	0.01	-
DBT (Digital Bathythermograph)	0.05	-
Drifting buoy	0.01	N/A
Glider	0.002	-
MBT (Mechanical Bathythermograph)	0.3	3%
MBT deployed from Soviet Union flagged ships	0.1	3%
MicroBT (Micro Bathythermograph)	0.002	-
Moored buoy	0.3	-
Profiling floats (pre-Argo)	0.005	-
Profiling floats (Argo***)	0.002	2.4 dbar
STD (Salinity, Temperature, Depth)	0.002	5 m
XBT (Expendable Bathythermograph) manufacturers other than Sippican and TSK and unknown manufacturer/type	0.2	<=230 m: 4.6 m >230 m: 2%
XBT deployed from submarines or Tsurumi-Seiki Co (TSK) manufacturer	0.15	<=230 m: 4.6 m >230 m: 2%
XBT Sippican manufacturer	0.1	<=230 m: 4.6 m >230 m: 2%
XCTD (Expendable Conductivity, Temperature, Depth) (pre-1998)	0.06	4%
XCTD (post-1998)	0.02	2%

- Pending assignment

N/A Not applicable

*** Argo profiling float data provides a standard error for each measurement for delayed-mode (quality controlled) cycles. This information was used for the IQuOD uncertainty value when available. The largest standard error for a variable for a cycle was applied to each measurement of that variable in that cycle.

World Ocean Database Quarterly Updates: 490,674 casts added by current update bringing total to 17,698,513
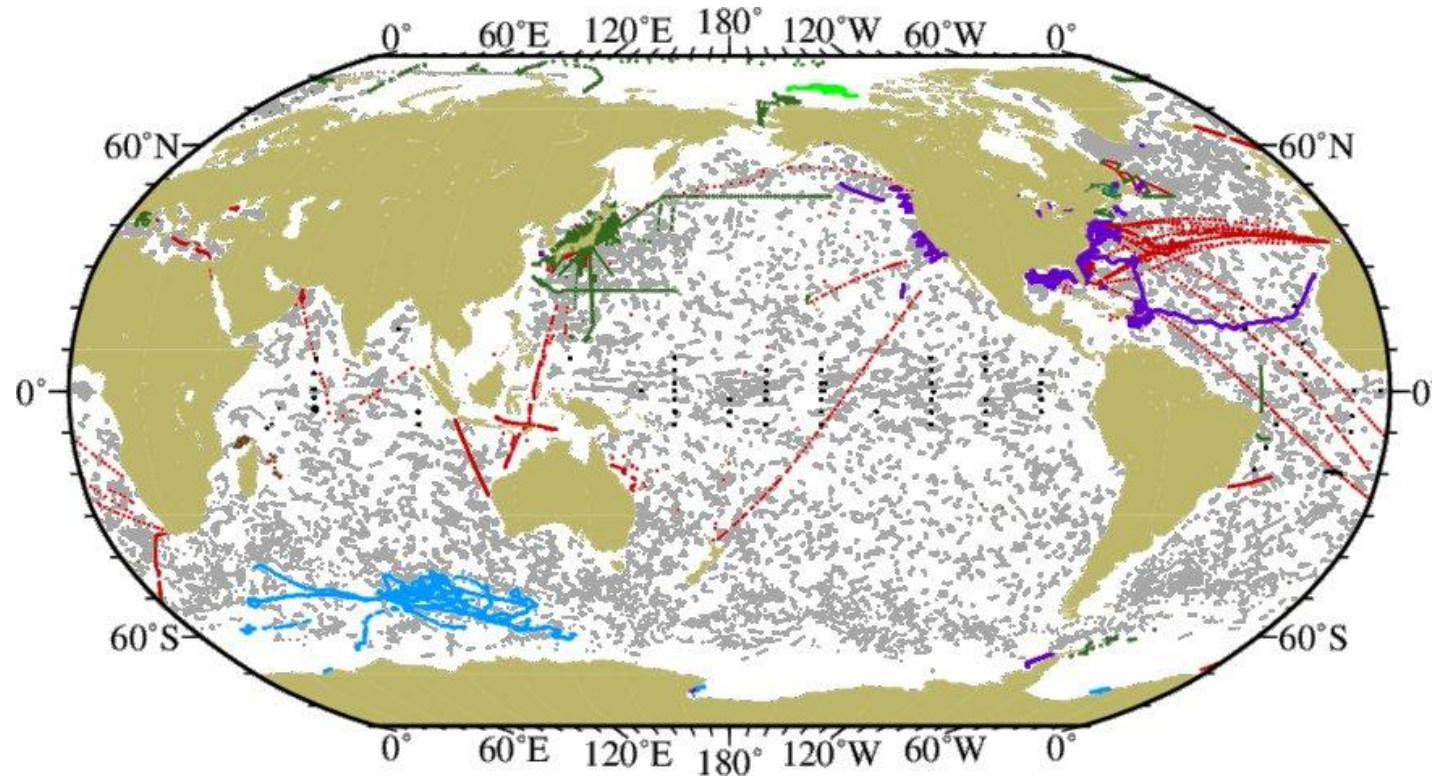
- 43,219 Argo cycles
- 2,816 bottle/CTD casts
- 2,756 XBT drops
- 428,256 glider cycles
- 5,066 tropical moored buoy daily means
- 8,019 pinniped dives
- 542 ice-tethered profiler cycles

Contributions from: PMEL tropical moored buoys, Global Temperature and Salinity Profile Program (GTSPP), CCHDO, Argo program, Ice Tethered Profiler Program (WHOI), CLIVAR, Carbon Hydrographic Office (CCHDO), University of Washington Applied Physics Lab, IOOS

Quarterly data flow into WOD for EOV time series (partial)
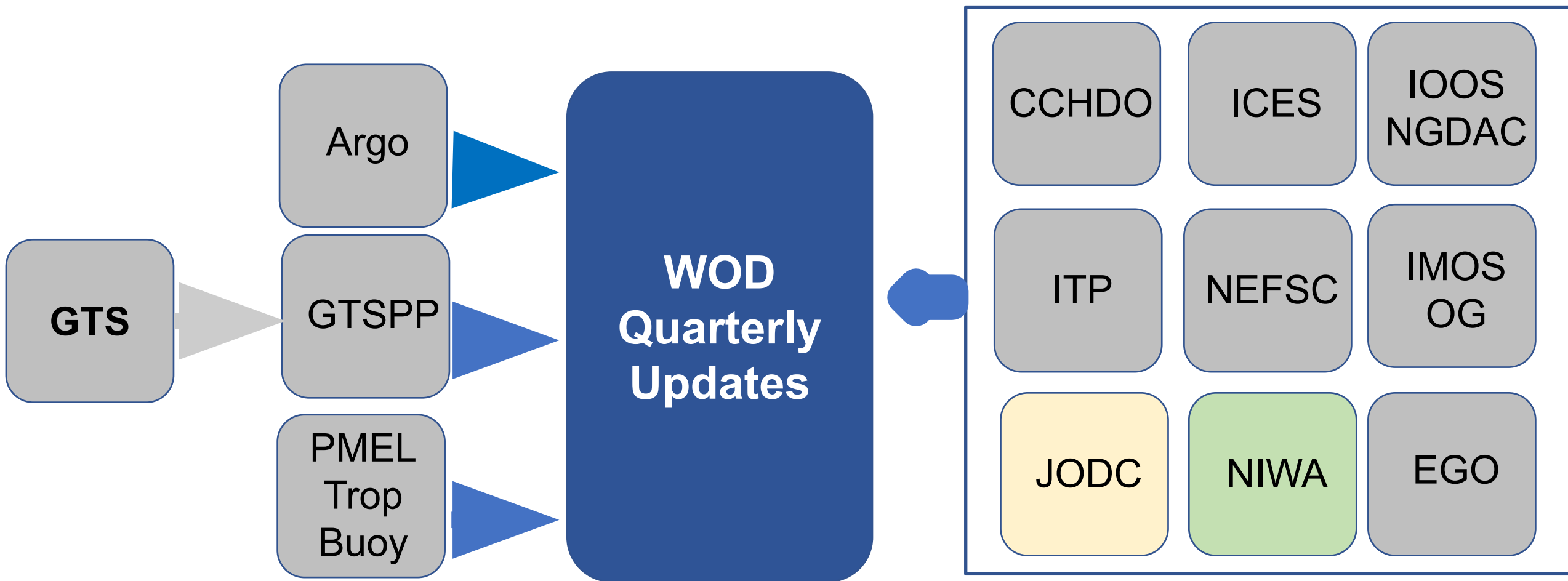
Near-real time data from quarter + delayed mode long-term data

Delayed-mode long term data yellow=yearly, green=intermittent

WOD in Global Ocean Monitoring and Observing (GOMO): Now

- **Unified EOV data access – all data relevant to multiple EOVs in one database, ameliorates difficulties of a federated system**

- **Fit for purpose quality control – in addition to good/bad measurements (mainly from originator) pass/fail of specific quality control tests for more uniform application to specific computations**

- **Cross-community expert participation in data aggregation, quality assurance (e.g. IQuOD)**

WOD in Global Ocean Monitoring and Observing (GOMO): in progress (I)

Equitable data access – FAIR principles do not necessarily mean equitable access.   World Ocean Database Cloud (WODc) working toward access to the data and tools to turn data into information in the cloud.   Data access no longer limited by computer resources or software expertise.

Dataset completeness – The goal is all available historic and recent ocean profile data for relevant EOVs accessible in the WOD. More community participation in uploading and archiving ocean profile data will be possible in the WODc.

WOD in Global Ocean Monitoring and Observing (GOMO): in progress (II)

- **Clear quality information – Completeness of data requires added responsibility clearly delineating quality of data for different purposes. IQuOD and WODc are working toward this for specific EOV (temperature). Incorporation of quality information from other communities (e.g. carbon, oxygen) is a working goal.**

- **Credit – it is difficult to clearly assign credit for data sets within a unified system.   WOD has a system based on referral to archived information, switching where possible to a data object identifier(DOI) based credit which will be much more direct, easy to cite.**